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Standard needs of the Italian primary schools(+)

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Abstract

The education sector in Italy is mainly public and highly centralized as concerns both financial and regulatory aspects. However, there are significant disparities in school spending across regions and in students' performance. This heterogeneity is also relevant in relation to the ongoing fiscal decentralization process that could lead to the assignment of responsibility for education to sub-central governments or, even more directly, to schools. The aim of the paper is to estimate the standard financial requirement for a sample of about 1,000 primary schools for the year 2009/2010, based on the demand of service (e.g., the number of students served, the type of school), and compare it with the current endowment in order to evaluate whether a better allocation of available resources can be obtained. Results suggest that the actual spending is quite far from the standard for all schools and most of them should benefit from a positive correction, receiving more resources to accomplish their tasks.

JEL Classification: H520, H700, I220, I280

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1. Introduction

Financing education in Italy and the role of different tiers of government involved are two issues open to debate also in the light of significant regional disparities in school spending and students' performance (international measures on Italian students' competences in math and reading show a wide territorial difference, but also one of the greatest between-school variances). Beyond these stylized facts, the ongoing fiscal decentralization reform (Law n. 42/2009) includes education among those services whose cost must be funded by the State in order to guarantee a standard level of service across the national territory, through an estimation of basic needs and according to standard costs (art. 8). Both the decentralization process and the wide gap in per capita education spending across regions seem to justify a general interest in the identification of the specific financial requirement for each school.

Devolution of power and tasks in education is not trivial. Several scholars and researchers (e.g., Technical Commission of Public Finance 2008; FGA 2010; Bordignon and Fontana 2010) affirm the benefits of moving towards some kind of "school federalism", based on higher autonomy and responsibility of Regions - or even directly of schools - in determining the main components of service delivery, including recruiting and hiring teachers and other school personnel. Hints from the international studies also suggest that better results in education can achieved through a combination of greater autonomy and accountability of schools (OECD 2004a, 2004b). Schools have a wider knowledge on the local context and specific needs of their catchment area, and should therefore be in a better position to decide on important school items such as the combination of input factors and the supply of education services (see also TreeLLLe Association 2006).

According to the ongoing debate, the central government would continue to determine the general rules and the basic principles of recruitment and contracting, and define a standard level of service to be guaranteed across the country. The State would fully fund the standard level of service, while the remaining expenditure, based on local preferences and choices or due to inefficiencies, would be covered by Regions. Well-defined indications and legislative prescriptions regarding the standard level of service for the education sector are still lacking, even though there are several references in the Constitution and more recent laws (e.g., art. 33-34 of the Constitution; Legislative Decree 226/2005; Law n. 53/2008) to ensuring the equality of access and opportunity to all students (for further details see Poggi 2010, 2011).

In the current setting, schools already have a certain degree of autonomy and manage their own budget as concerns promoting specific teaching initiatives, extra-curriculum projects, daily functioning needs and equipment, and connecting the school to the territory.[1] Whatever the developments of the fiscal federalism reform, school funding criteria should be based on school needs rather than on their

[1] Since the nineties, Law n. 59/1997 (and subsequent Legislative Decree n. 112/98 and Presidential Act 275/1999).

historical record. The central government could drive improvements in the efficiency and efficacy of the education function, by allowing schools more flexibility in the use of funds (for example, more extra-pay to the existing staff rather than the purchase of external services or the choice of specific projects) but enforcing a "hard budget constraint" on the total amount transferred. In this perspective, a standard requirement must be defined for each school and it should be compared with the current endowment, to evaluate whether - and where - adjustments should be made in order to overcome the so called "past cost" criterion – and move towards a "standard cost" principle.

In this paper, we estimate the standard financial requirement for a statistical sample of about 1,000 schools (referring to two main categories, primary and comprehensive institutes; the latter delivers both primary and lower secondary education) for the 2009/2010 school year. Drawing data from different sources (the Ministry of Education, *MIUR*; the National Statistical Office, *ISTAT*; the Ministry of Economy and Finance, *MEF*; the National Education Evaluation Institute, *INVALSI*) including the school budgets, the sample combines information on the physical inputs (teachers, administrative staff), major outputs (number, specific features and performance of students) and school expenditures for ordinary running tasks from the 2010 school budgets. A number of exogenous factors that can influence the school needs and might be appropriately considered in the standardization process are also taken into account.

Our estimation of the expenditure function takes into account resources needed to fund the main components to deliver school services (regardless of who is now paying the burden, i.e. the central government, the local government or the school itself). Moreover, the differential in spending requirements should reflect only differences in the structural characteristics of the demand for school services; all non-structural determinants of per student spending (e.g., citizens' preferences and income) should, instead, be not relevant to determine the relative school needs.[2]

Compared with the existing literature on the Italian case, the novelty of our paper lies in considering the needs of each individual school rather than some form of regional requirement (e.g., Biagi and Fontana 2009; Bordignon and Fontana 2010; IRPET 2012), attempting a bottom-up approach. The methodology adopted also presents similarities with the estimation of standard needs for Italian local governments (e.g., Rizzi and Zanette 2011; Petretto 2012) and with other analyses focusing on the cost of peripheral offices of the central administrations (Technical Commission of Public Finance 2008; Giarda 2012).[3]

[2] This approach is also adopted in studies determining expenditure needs of local governments (see for example Eichhorst 2007). Following this literature, another strategy implies the standardization of such variables which are non-structural in order to consider them as determinants of municipal (or regional) spending requirement (e.g., Bradbury and Zhao 2009).

[3] In general, the literature on the standard needs is essentially based on two distinct approaches: a) models estimating expenditure functions according to the *Regression-based Cost Approach* (for a detailed survey see Kim and Lotz (2008)); b) models estimating a production function (as an example, IFEL (2010) uses it to determine costs of the local police, the nursery service and the registry office). Most Italian studies on local governments adopt the *RCA*, where the dependent variable is represented by per capita historical spending provided by each municipality to implement its essential functions. Finally, among methods based on historical data, an alternative approach is referred to *Representative Expenditure System* as pointed out by Yilmaz *et al.* (2006).

It is worth remarking that the result of our approach does not tell us the real cost of achieving any specified level of service as it provides, instead, estimates of average spending at current performance and efficiency levels. Notwithstanding, estimating the cost function can allow a relatively straightforward calculation of alternative indices for policy analyses and preliminary evidence on how unbalanced the current resource allocation is. Broadly speaking, in our case it makes sense to assume that standard costs refer to the quantity and characteristics of the service provided rather than to its quality in terms of students' learning (i.e. passing exams or scores in national assessments).

The remainder of the paper is organized as follows. After a review of studies using either cost or production functions in the education sector (section 2), we briefly describe the Italian school financing system and provide some data on regional education spending (section 3). Then, we explain the model, the data and the empirical analysis performed (sections 4 and 5, respectively). The results are presented and discussed in section 6. Finally, some concluding remarks, policy implications and issues for further research are provided in section 7.

2. A summary of the literature review

There is a wide literature on educational production and cost functions. Most of the available research focuses on the United States, using data at county, district or school level; some looks at school costs in Canada (Wales 1973; Kumar 1983), while only a few have been undertaken in other countries such as the United Kingdom (Bee and Dolton 1985), Belgium (Smet 2001), Australia (Hind 1977), Japan (Oshio *et al.* 2010).

Depending on the specific research purposes, cost or production functions are adopted. The main difference between the two is that the former estimates the resources required to satisfy the levels of service delivered taking into account typical demand or contextual factors; while the latter estimates the output produced (typically students' performance) using a combination of resources. The rest of this section reviews and discusses the key elements from the empirical studies adopting the cost function method.[4]

Cost functions typically connect district/school spending to students' performance, and consider prices of inputs, students' characteristics, and other relevant context features. Differences in predicted spending provide helpful information regarding the extent to which factors outside of the school's control can affect the education cost (Gronberg *et al.* 2011). Such insights can be relevant for the policymakers interested, for example, in including performance standards into the school financing formula or in ensuring that schools have the resources necessary to meet certain standards. Indeed, several studies following the cost function approach use a variable represented by students'

[4] See Golebiewski (2011) for an extensive review of cost functions in the field of education. Likewise, recent works of Hanushek (2010) and Oshio *et al.* (2010) can be seen for an overview of production functions.

performance on state exams (Duncombe and Yinger 2005) or on average scores exams (Downes and Pogue 1994).[5]

However, performance levels may be uncorrelated with school expenditure (Duncombe and Yinger 1997; Reschovsky and Imazeki 2001; Imazeki and Reschovsky 2005). Empirical evidence in the field of human capital formation often concludes that more input does not necessarily imply higher students' performance, skills or competence (Hanushek 1997; Bratti *et al.* 2007; Hanushek and Woessmann 2008, 2011; Montanaro 2008). Additionally, there are no agreed measures on the "quality" of the inputs (mainly teachers). Thus, including variables on students' performance in the cost estimation is a controversial issue, as they tend to be linked to quality, efficiency and efficacy of spending rather than to the level of spending itself.

The item one can really observe is spending or actual expenditure, which can differ from the cost by the level of efficiency through which schools operate (Duncombe *et al.* 1995). Actual expenditure reflects the influence of not only cost factors, but also demand and institutional factors. Many studies highlight the importance of educational cost differences across territories (or school districts in the case of the United States) and try to analyze how these differences can be incorporated into broad school reforms and those concern the financing mechanism.

The level of school expenditure per pupil[6] is the typical dependent variable, while the main input purchases and other specific-school factors, potentially affecting the costs, are considered as explanatory and control variables. Some previous examples of this approach include Callan and Santerre (1990), Ratcliffe *et al.* (1990), Gyimah-Brempong and Gyapong (1992), Downes and Pogue (1994). Among the most frequently used variables, there are teachers and other school staff salaries, expenditures related to operation and maintenance of schools, enrolments (also to capture economies/diseconomies of scale), institutional school characteristics (e.g., school location; the number of subjects offered; the type of school; the percentage of students in special education needs). Teachers' salaries represent the major expenditure item, depending on a number of characteristics belonging to both the teacher (age, education, experience, tenure status) and the school district (e.g., the cost-of-living; the percentage of disadvantaged students).

In this paper, we adopt the cost function approach as we are basically interested in estimating a function that takes into account resources needed to fund the main expenditure components of a school. It is worth noting that the standard level of spending does not actually imply an "efficient production cost" [7] as it refers to the amount of per student expenditure that each school should finance

[5] More recently, some scholars start to use performance measures that are in value-added form by comparing test score information on the same cohort in different grades in an effort (e.g., Reschovsky and Imazeki 2003).

[6] Average school expenditure is measured in a number of ways. Kumar (1983) uses total current expenditure per student. Other studies use variations of this, such as operating expenditures per student (Riew 1966; 1986) or fees charged per student (Watt 1980). Expenditure per student and cost per student are used interchangeably in the literature (see Riew 1986) and also in this paper.

[7] On theoretical grounds, the main problem appears to be that the cost function method presumes that schools are attempting to provide the designated outcomes at minimum cost. Yet, public schools cannot follow the same logic of private firms as they are likely not profit maximizing, so they are not forced to minimize costs in providing education services. If it is true,

and support in accordance with the average spending patterns of other schools with similar structural characteristics (e.g., size, type, students' composition). Although this approach has some limitations, it fits the purpose of determining a standard level input based on actual demand rather than on the so-called "historical expenditure".[8]

3. Main features of the Italian education financing system

Education spending in Italy is about 3.5% of GDP; this ratio is slightly lower than OECD average, 3.8% (OECD 2009). The Italian school system is mainly public and highly centralized as concerns both financial and regulatory aspects. The role of the central government in education spending basically concerns teachers and staff's salaries and their recruitment; while local governments support costs for school buildings and are responsible of organizing the school network. Provinces deliver directly to higher schools over their jurisdiction financial resources to functioning costs (telephone, photocopies, etc.) and routine services; likewise, Municipalities provide the same contribution concerning preschool, primary and secondary (first level) schools. Regions, in turn, annually define the school network planning, lesson and class timetable; on average, their funds for education spending are smaller (with the exception of Special Statutory Regions, SSR).[9]

The total amount of resources spent in education in 2009 (latest data available from MIUR 2011) was about 54.6 billions of euro (6.8% of total public expenditure), whereby 82.6% of such expenditure was paid by the central government; 14.2% by both Municipalities and Provinces (with the highest amount by the former); 3.2% by Regions. The financing composition reveals the strong incidence of State spending; indeed, more than 85% represents school personnel (teachers, administrative and technical staff, directors) and its annual gross salaries, with the exception of some mandatory expenses paid directly by schools (such as compensation for short-term substitute teachers; allowances to members of state exams committees; teacher subsidiary payments). Salaries are uniform across the country and they have a higher weight in poorer regions. On the other hand, education spending provided by local governments (mainly Municipalities) reflects the wealth of territories; as an example, in the North local authorities' expenditure is significant and above the national average.

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the cost function analysis may be misleading. Indeed, several studies in this sector explore efficiency issues by implementing non-parametric (e.g., *Data Envelopment Analysis*) or parametric techniques (such as *Stochastic Frontier Analysis*) in order to take into account efficiency considerations (among them, see Ruggiero 1996 for the US; Mancebon and Molinero 2000 for UK; Alexander *et al*. 2010 for New Zealand; Di Giacomo and Pennisi 2012 for Italy).

[8] Contrarily to studies interested in explaining the observed expenditure and then separating demand factors related to local preferences from those related to structural factors (for example through a two-stage regression, wherein local preferences are fixed at a constant level at the second stage), we perform a one-stage regression referring to structural demand factors only to determine the standard expenditure requirement. We then analyze residuals and identify whether local preferences or efficiency issues play a role in explaining over- or underfunding patterns.

[9] These regions do not receive transfers from the central government and they provide resources directly to schools (on average, more than 80% of regional transfers go to the education sector) instead of assigning money to local governments (i.e. Provinces and Municipalities). For all these reasons, SSR show a higher degree of autonomy than that of Ordinary Statutory Regions (OSR) in shaping and organizing their school system.

In order to explain the main reasons driving regional differences in education per capita spending, we provide - without any claims of completeness - a short list of factors contributing to determine such disparities and influencing, for example, the local demand of teachers and, therefore, the average expenditure per student. Firstly, we have the size of classes and schools, whereby some scale economies should be possible. Demand factors related to the percentage of full-time classes in primary schools and that of extended/long time in lower secondary schools also count: having many classes with full/long time leads to higher costs for school personnel (e.g., administrative staff and teachers) and organization; in turn, this surely implies higher per capita school spending in each region.

Moreover, within the Italian context, per student expenditure is affected by the number of students with special education needs, given that specific support teachers are assigned to them. For the school year 2007-2008, the ratio between pupils with disabilities and support teachers is equal to 2 at the national level and it shows wide variations across regions (e.g., 1.4 for Basilicata, 2.6 for Abruzzo).

As for school personnel generally considered, two issues are also relevant: age (seniority) and contract (i.e. fixed-term or permanent). An uneven distribution of teachers - with different ages - over the country can partially explain regional differences in per capita education cost. For example, recent data show that, on average, older teachers (with age over 50) work in Southern schools and younger (with age until 48) in the North (see MIUR 2008). The average salary of a permanent teacher is higher than that of a fixed-term teacher (some exceptions may happen at the beginning of the career when they are very similar) and, among temporary teachers, some have a full year term, while others have a contract covering only the actual school months. Expenditure per student is therefore increasing with the share of full-time teachers over the total; this seems more frequent in the South of Italy, wherein more than 81% teachers' contracts are full-time.

As we will show in the next sections, the variability between regions is high, as well as the variability within regions. For this reason, focusing on regional aggregates (e.g., the average) is not as useful as performing an empirical investigation at the single school level.

4. Data and model

In this section, we present the methodology used to estimate the standard school requirement for a sample of about 1,000 Italian schools, wherein primary and comprehensive institutes (i.e. schools where both primary and lower secondary education are delivered) are included for the 2009/2010 school year. The sample is representative of primary schools at the regional level and used in the 2009/2010 national students' assessment conducted by the INVALSI. Data from different sources of

interest were available for 1,083 primary schools (among 1,307 of the initial INVALSI sample).[10] It is a two-stage sample (first the schools are selected, then the classes in which the national assessment is held) and includes both public state schools and private schools.

For the purpose of this study, only public schools financed by the central government were considered.[11] Following the mainstream on education cost functions (Riew 1966, 1986; Kumar 1983; Downes and Pogue 1994; Duncombe *et al.* 1995; Reschovsky and Imazeki 2001; Duncombe and Yinger 2005), we consider school spending as the sum of input purchases and estimate per student expenditure function implementing a multiple regression, OLS, with robust standard errors.

Our research question is the following: how many resources should be given to each school *to deliver ordinary running services?* In doing so, two scenarios have been considered. In the first case, we represent the current framework wherein schools are responsible only for operation spending but not for teachers and administrative staff expenses, which are directly handled by the State. Hence, we explore whether - and how - physical characteristics (e.g., the type of school, its size), exogenous demand factors (e.g., the number of students and those with special education needs; the percentage of full-time classes), and environmental features, which could have an impact on school costs, affect per student spending. Expenditures related to teachers and school staff are not considered under this scenario as they do not pertain to schools' decision-power and autonomy (they are paid and allocated to schools directly by the central government).

In detail, we estimate the following model:[12]

$$\left(\frac{schoolEXP}{n°student}\right)_i = \alpha + \sum_{i=1}^{n} \beta_i x_i + \varepsilon_i \qquad (1)$$

[10] The loss of observations is contained and does not cause an appreciable distortion in the statistical representativeness of the sample. Table A.1 in the Appendix shows the regional coverage of the sample used for estimation of the standard needs compared with the initial INVALSI sample.

[11] Although included in the INVALSI sample, schools of Valle d'Aosta and Trentino Alto Adige are not considered (these autonomous Regions fund public schools themselves). Seventeen outliers were eliminated from the analysis. Although less accurate, the sample representativeness should not be generally damaged by this, as outliers were a few and distributed among regions. For further details on the sample, see INVALSI (2010).

[12] The choice of such functional form to estimate per student spending is the most common in the previous education literature and it allows a straightway interpretation of the estimated coefficients combined with the fact that all variables are expressed in level. In any case, we can anticipate that results remain qualitatively unchanged adopting a logarithmic transformation of all variables. Another possible functional form is the translog, which represents a proxy to an unknown cost function obtained from the second order Taylor's expansion of the logarithmic form around a vector 0 of size $n+1$; the variables included in this function must be therefore expressed as deviation from the vector 0. The translog is the most flexible function with the advantage of using less restrictive specifications than other forms (e.g., Cobb-Douglas). However, its primary disadvantage is the increased complexity in evaluating marginal effects, and the statistical concerns with multicollinearity and over-parametrization due to the presence of many interaction terms involving the explanatory cost factors. It is more properly applied in contexts whereby multiple output measures (or products or goods or functions) are provided such as multi-product firms, banks, municipalities and so on. In addition, when determining an expenditure function through the translog, the interpretation of the estimated coefficients is not so direct but it is necessary to isolate the effect of each variable all other characteristics being equal. Some examples of the adoption of the translog function are: Rizzi and Zanette (2011) for Italian local governments' expenditure needs (in detail, they use a reduced form); Crivelli *et al.* (2001) for the costs of hospitals in Switzerland. To our knowledge, in the education sector, almost all studies use a simple linear or log-linear functional form for the cost model. Few exceptions adopting the translog form are: Butler and Monk (1985); Callan and Santerre (1990); Gyimah-Brempong and Gyapong (1991); Andrews *et al.* (2002).

where *i* represents the base unit of our analysis, which is the school. In this scenario, the dependent variable captures the school operation costs and all the activities promoted by schools in force of their autonomy and decision power.

More precisely, the dependent variable is the total current expenditure of the school budget net of both EU structural funds[13] and family or private sector contributions.[14] The latter are excluded to focus on a more homogenous expenditure variable across schools and neutralize the effect of specific features pertaining to local preferences or situations. Indeed, the 2007-2013 EU structural funds programming cycle direct a conspicuous amount of resources to schools in four regions of Southern Italy (referring to our sample, the peak is in Calabria with about 100 euro per student, followed by Sicily with about 56 euro per student) with the aim of narrowing the disparities in students and schools' performance, and enhancing the quality of human capital in the more depressed areas of the country. These are additional and temporary resources, on the top of ordinary and continuous funding, and concentrated only in a few regions as shown in Table 1.

Insert Table 1 about here

With regard to family or private sector contributions, these are essentially divided in two groups: fees and voluntary contributions. The incidence of these components has a strong regional variability (on average, in our sample it is more than 65 euro per student, whereby Lazio presents the highest value of about 152 euro per student, while Calabria reports the lowest with 34 euro per student). Indeed, these depend on local preferences but also on the social and environmental context and should not influence the amount of school funding for basic functioning purposes. Furthermore, fees really concern only higher secondary education, while this study focuses on primary schools.[15]

Finally, we consider only current expenditure; in any case, the share of capital expenditure is very low mainly because school buildings are owned and cared for by local governments (on average, it amounts to 10 euro per student). Moreover, it would be distorted to consider this kind of expenditure on a one-year basis, as it typically concerns longer term strategies. Differences in school budgets can arise also because of their discretion in the allocation criteria used by schools due to the mismatch between school activities (planned on a school year) and the annual budget based on the financial year.

[13] The amount of EU funding spent from the school's budget is not available in our dataset. The only proxy for this is the amount of EU financial support actually collected in the same year. The main limit of this variable is that part of the EU funds may be used to finance capital expenditure; therefore, the simultaneous deletion in the empirical model of capital expenditure and revenue from the EU can bring, at least for some schools, to an under-estimation of current expenditure.

[14] Family and private sector revenue may be earmarked for specific projects. The school's budget provides evidence on the amount cashed in.

[15] According to Law n. 40/2007 (art. 13), such contributions should be basically aimed at: technological innovations, school buildings, developing and enriching cultural and educational provisions for pupils. In practice, in primary and lower secondary schools, private sector revenue is mostly due to voluntary contributions from families, used to promote special initiatives or projects and school trips. On the other hand, mandatory contributions cannot be asked from public schools to families to finance ordinary and curricular educational activities (such as photocopies, teaching materials, and so on). Tuition fees only concern higher secondary schools; exemptions from payment can be allowed according to economic reasons, merit issue, and for belonging to special categories of beneficiaries (see Legislative Decree n. 297/1994, art. 200).

Among the explanatory variables (x_i), we include the total number of students and its inverse to describe the school size and, at the same time, take into account fixed costs and their variable effect on per student spending;[16] the percentage of disabled students over the total number of pupils to capture the share of students with special education needs; a dummy variable for the type of school ("specialized" that exclusively focuses on primary classes *versus* comprehensive schools that include both primary and lower secondary classes), the number of service delivery points and the share of full-time classes to represent school organizational aspects.

Finally, we build two dummy variables for geographical and environmental factors (such as the urbanization degree of the municipalities and their altitude) and insert them into the estimation as covariates. The error-term is represented by ε_i. Descriptive statistics for the explanatory variables are reported in Table 2.

Insert Table 2 about here

In the second scenario, we extend the previous analysis by considering a wider school spending aggregate as dependent variable. In detail, we assume that personnel expenditure and recruitment functions are both direct competences of schools. To some extent, this represents a completely "decentralized scenario", wherein schools' responsibilities and autonomy are wider and concern both school expenditures coming from their budget and those administrated and provided by the central government.

The covariates are the same variables (x_i) used in equation (1); while, μ_i is the error-term. Therefore, we estimate the following model:

$$\left(\frac{schoolEXP + staffEXP}{n°student}\right)_i = \alpha + \sum_{i=1}^{n} \beta_i x_i + \mu_i \quad (2)$$

The dependent variable is calculated as the sum of current payments from the school budget (net of EU structural funds and family/private sector contributions, as before) and those for the school staff (i.e. both teachers and administrative personnel salaries) on the total number of students in each school. In detail, payments for school personnel are obtained by summing the average gross annual salary for each type of contract (i.e. fixed-term or permanent) for both teachers and technical-administrative staff (namely *ATA* in Italy). As for both permanent teachers and *ATA*, the annual salary

[16] Indeed, it can be assumed that the relationship between total education expenditure and the student population has a quadratic form - $Exp = a_0 + a_1*student\_pop + a_2*student\_pop^2$ - characterized by some economies of scale. Dividing by the total number of students in each school, we get the following equation for per capita education spending: $Exp\_per\ student_i = a_0 + a_1*inverse\_student\_pop_i + a_2*student\_pop_i$.

is the average of the seven seniority classes;[17] seniority does not influence, instead, the salary of fixed-term employees. Finally, the salary of support teachers (usually hired for students with special education needs) follows the same rules, so the key variable remains the type of employment contract, i.e. temporary or full-time.

As shown in Table 3, average school expenditure in our sample is 631 euro per student; regions in the Centre and South exhibit higher values than those in the North, despite the fact that revenues from EU structural funds have been removed. However, it is the remarkable variability of per pupil expenditure that raises several questions on the current funding mechanisms: the maximum value is more than fifteen times the minimum. When the school personnel is taken into consideration as well, average expenditure is just under 4 thousand euro per student. Differences are somewhat flattened as a consequence of the predominant weight of the salary component, but variability is still substantial as total expenditure ranges from just under 2.4 thousand euro per pupil to over 7 thousand euro, suggesting that there may be room for a more evenly balanced allocation of resources. Note that in both scenarios, the variability of the dependent variable is much higher in the Southern regions than in the Centre-North.[18]

Insert Table 3 about here

Data for both analyses come from various official institutions and sources; the most extensively used are: the MIUR for basic information on schools and their budgets; the MEF for information on salary levels; the INVALSI for students' test scores in math and reading; the ISTAT for some geographical variables.

5. The empirical analysis

Table 4 reports the estimation results for the first model, referring to the current scenario. Per pupil spending has the expected relationship with the independent variables and these latter are statistically significant and different from zero. The coefficients on school size including the effect of fixed and variable costs, i.e. the number of students and its inverse, confirm the existence of scale economies as they are respectively negative and positive (even one significant at 5%).

Insert Table 4 about here

[17] Their wage is indeed a positive function of seniority but data on age of them are not available, so we calculate the average of the seven classes of seniority.

[18] The data in Table 3 (used as dependent variables for the empirical analyses) include basically the central government financial contribution to education, excluding local governments' expenditure mainly related to the maintenance of school buildings.

Another expected result concerns students with special needs: the positive regression coefficient (at 1% significance level) on the share of disabled students confirms that they require additional services and support (for example, additional hours of personnel, specific building characteristics and equipment),[19] which raise schools costs. On average, schools with disabled students should spend 29.3 euro more per pupil. In turn, the percentage of students attending full-time classes over the total shows a positive coefficient (but with a lower magnitude than that on disabled pupils and at a lower significance level, 5%) as well as the number of service delivery points. The fact that a lower amount is needed, on average, to guarantee full-time classes instead of services to disabled students is probably due to a higher concentration of the former element across schools of the sample (see also Table 2).

On the other hand, all other factors equal, being a comprehensive school (those with the dummy variable "type of school" equal to 1) seems to lower the costs. This empirical exercise shows that, compared with "specialized schools" with similar characteristics, the common management strategy of a comprehensive school leads to some kind of savings, quantified in, on average, 75 euro per student.

Finally, the model seems to suggest that schools in bigger cities (i.e. more urbanized municipalities) and those located in a mountainous and more remote locations do not appear to incur in a differentiation of expenditure for ordinary operations.[20] In other words, the scale economies have been already embodied in the school size components.

Although we consider factors that are able to determine different allocation of resources among schools when they have to implement their ordinary and routine functions, the model lacks explanatory power. Its *R-squared* index barely reaches 0.19, indicating that other meaningful factors are left unconsidered or that the specification is not sufficiently appropriated. In the attempt to better understand the phenomenon, the model has been estimated on sub-groups of schools, however with no further improvements. Other estimations were run by using the sum of spending commitments (instead of effective payments) from the school budget (net of EU structural funds and family/private sector contributions, as before) as dependent variable. However, also in this case, the explanatory power of the model is not so high (*R-squared* is about 0.18) and the variability of commitments is higher than that of current payments. Finally, presuming there maybe group patterns according to the size of the school or its main organization feature (specialized or comprehensive), the estimations were run on separate groupings of schools (e.g., by type, by classes of size), basically confirming the sign of the

[19] Note that the ordinary school expenditure considered in this scenario includes extra-hours and salary accessories for staff. In the current framework, a fixed amount of resources per unit of personnel is transferred form the central government to schools on the basis of contractual arrangements. This means that where there is more staff (whether necessary or not), the school will be "richer". Typically, an increasing share of students with special needs increases the share of teachers per pupil.
[20] We do not report their coefficients in Table 4 as they result not significant even at 10%.

coefficients and level of significance of the variables, but providing no further insight or explanatory power.[21]

Of course, one important factor affecting the variance in expenditure is short-term substitutes the school might have to pay for when teachers are absent. This should be a totally random variable (due to illness or sporadic cases of sabbatical leaves), affecting all schools with equal probability, but it may display a particular concentration on a one-year basis. Indeed, it would be more appropriate to look upon the average expenditure over a few years, whilst we rely on the school budget data only for 2010. The data could also be affected by lack of homogeneity and consistency across schools in recording practices. Furthermore, revenue from local authorities may vary strongly across the country and even within the same type of authority (Region, Province, Municipality); beyond this, specific agreements between schools and local governments may affect the type of school services offered and who is actually financing them (a typical example is lunch canteens). This heterogeneity makes difficult to quantify the *de facto* standard requirements of each school and justifies, in part, the low fit of the model based on the current scenario.

Results of the second specification – referring to the completely decentralized scenario – are more encouraging, starting from the explanatory power of the model (*R-squared* around 0.70) as shown in Table 5.

Insert Table 5 about here

In this case, the data are more stable from one year to another as personnel expenditure is a structural spending factor. Explanatory variables follow their expected behaviour. Scale economies linked to the size of schools (e.g., the total number of students served) are persistent and their magnitude increases. Beyond the higher magnitude, the coefficient on the share of disabled students also shows the highest significance (as in Table 4), which is consistent with the fact that here the dependent variable includes the salary of teachers, and some of them are basically engaged to take care of students with special needs. About 121 euro more per student are required for a one percent increase in the share of such students, all other factors equal.

An increase due to the percentage of full-time pupils also occurs - at a higher level of significance, 1%, while before 5% - and it consists, on average, of 8.3 euro more. The increasing number of service delivery points and being a specialized school also imply a higher per pupil spending. In this case, the positive sign of both these variables is mainly driven by the fact that the salary of school staff (beyond that of teachers) contributes to determine per student expenditure; when the school organization becomes wider, more technical and administrative personnel is likely to need. Finally, schools working in more urbanized municipalities and those located in more mountainous area do not seem to

[21] Results are not reported in the paper but they are available upon request.

incur in higher expenditure even when they start to perform all educational functions, consistently with the results of the previous scenario.

6. Results and discussion

By comparing the observed value with the estimated standard per student spending in each school, we can evaluate overfunded and underfunded schools. A positive (negative) gap between actual and fitted expenditure highlights schools supporting a higher (lower) spending than that provided, on average, by such schools with similar structural characteristics. In this perspective, Figure 1 represents per pupil spending under the current scenario according to the observed (blue) and fitted (red) values. Likewise, Figure 2 shows the actual *versus* estimated values of per student expenditure concerning current payments from the school budget plus those for the school staff, i.e. the decentralized scenario. In both figures, the total number of students is reported on the horizontal axis.

Insert Figure 1 and Figure 2 about here

With a view of providing hints on the financial effects of adopting a funding mechanism based on the standard, further considerations are limited to the decentralized scenario, given the more convincing and higher predicting power of the model, and our interest in the ongoing fiscal decentralization process, where personnel recruitment powers could be effectively assigned directly to schools (with no need to modify contractual arrangements on salaries or teacher certifications).

Table 6 reports, in the first column, the mean of the fitted values of per student spending from the school budget including the education staff expenses calculated for all schools in each region; the remaining columns contain some descriptive statistics on the difference between observed and fitted values for each school at a regional level.

Insert Table 6 about here

It is worth noting that the difference ranges from an average of +287 euro per student in Calabria (followed by Sardinia with +256 euro) to an average of -210 euro per student in Marche (followed by Molise with -199 euro per student). Positive values (marked by grey) indicate that in these regions the overall school expenditure is more than its standard requirement, while negative values highlight, in turn, the opposite trend, i.e. the current endowment is lower than the estimated standard. To summarize, Table 6 shows that, in aggregate, schools in Central and Southern regions (e.g., Lazio, Campania, Apulia, Basilicata, Calabria, Sicily and Sardinia) should basically receive fewer resources, while those in the North and other areas of the Centre (including Tuscany, Umbria, Emilia-Romagna, but excluding Friuli and Abruzzo being both in a more balanced situations) should receive more.

To draw more detailed conclusions starting from these results, it can be useful to normalize this difference on the basis of the observed values and evaluate such ratio in percentage terms. Hence, we build a new index and calculate it for each school. Additionally, we group and rank the values of such index (from about -38% to +28%) into six classes, passing from the most "positive" (namely "1") to the most "negative" (namely "6"). When schools fall in classes 1, 2 and 3, it means that they are "underfunded" and should be receiving a higher percentage of resources to meet the standard. On the contrary, when schools fall in classes 4, 5 and 6, they are "overfunded" and should be receiving less resources (class 6 means that the gap over the observed values is more than 20%; thus, such schools should receive at least 20% less to be funded according to their standard requirement).

Table 7 describes the distribution of frequency and percentage of schools belonging to each of the six groups at a national level.

Insert Table 7 about here

There are, on average, more underfunded than overfunded schools (54.4% *versus* 45.6%), although the magnitude overfunding against the standard tends to be greater. Indeed, 2.3% of schools spend at least 20% more than their standard (class 6), while only 0.2% of them actually spend from 30% to 40% less than their standard (class 1). However, the majority of schools would require at most a 10% correction (positive, so overfunded, in 33% cases of the sample; negative, so underfunded, in 38.1% cases of the sample).

At the regional level (Table 8), the heaviest cuts would be applied to schools in Calabria, where 10% of schools would receive 20% less to satisfy the standard. The same holds for 7.4% of schools in Apulia (6.6% in Sardinia, 3.7% in Abruzzo and 3.5% in Molise). Overfunded schools also exist in Emilia-Romagna and Friuli, although in smaller shares (2.8% and 2%, respectively).

Insert Table 8 about here

At the other extreme, schools deserving a more than 30% increase in their actual budget (class 1) are concentrated in two regions: Marche (1.6%) and Umbria (2.2%), consistently with the previous results (see Table 6). The most widespread occurrence across regions still remains class 3 (from -10% to 0), signalling that many schools in each region could spend up to 10% more to satisfy their estimated benchmark. In particular, this holds for schools in Liguria (51.9%), Veneto (48.7%), Piedmont and Abruzzo (about 46%), and Tuscany (45.2%), denoting that about half of schools in these regions should be receiving more resources. The most frequently underfunded schools appear to be in Molise (where 48.3% of schools fall in class 2, so calling for an increase in their resources from 10% to 30% more), while the most frequently overfunded schools are in Umbria (where about 51.1% of schools fall in class 4, so indicating that they spend 10% more than their standard requirement).

Finally, by summing up the percentage of schools falling in the first three groups (i.e. with a negative gap) and those in the last three (i.e. with a positive gap), one can see that in almost all regions more than 50% of schools should receive from 0 to 40% resources more in relation to the defined standard, while only in few regions (e.g., Sardinia, Calabria, Campania, and Apulia) the same share of schools should receive less - from 0 to 20% - with respect to their standard requirement.

Regions apparently displaying similar features might conceal very different situations in terms of the distance from school standard expenditure. Calabria, for example, presents the same average number of service delivery points (3.0) and a similar average number of students per class (20.2) than Marche (respectively, 3.1 and 20.9); however, summing up all discrepancies from the benchmark, the former region results as the most overfunded (+287 euro per student), while the latter is the most underfunded (-210 euro per student). In turn, many over-spending of schools in Apulia and Campania (see Table 8) appear, to some extent, more difficult to justify as such schools have a lower number of service delivery points (1.9 and 2.2 on average, respectively) and, at the same time, a lower number of teachers per 100 student (9.29 and 9.48 on average, respectively) compared with both the national values (on average, 10.4).

On the other hand, in Veneto, in order to finance an average 3.5 service delivery points (against a 2.9 national average) and provide all education functions to 21 students per class, more resources are needed; this is confirmed by the fact that about 3/4 of schools in this territory should receive resources upon 30% more in relation to a gap of -175 euro per student to meet their standard (see Tables 6 and 8).

The results discussed up to now do not take into account efficiency or quality issues. In other words, the estimated models do not consider that spending over or under the standard may be due to differences in quality of the services provided and educational results obtained. However, these could be contributing to the level of observed school expenditure in various ways. In a view of exploring this issue, we try to perform a second step of the analysis, whereby students' performance levels and school context factors (such as the average social and economic background) are used to explain the residuals emerging from the estimation of equation (2), i.e. the decentralized scenario.[22]

In this perspective, we explore the relationship between overfunding (underfunding) and schools' performance as follows:

(3a) $$\hat{\mu}_i = \lambda + \gamma_1 (AVE\_SCORES_i) + \gamma_2 ESCS_i + \theta_i \text{, with } \hat{\mu}_i > 0$$

(3b) $$\hat{\mu}_i = \lambda + \gamma_1 (AVE\_SCORES_i) + \gamma_2 ESCS_i + \theta_i \text{, with } \hat{\mu}_i < 0$$

[22] The lack of explanatory power of the benchmark model related to the current scenario - equation (1) - does not justify a similar analysis.

where $\hat{\mu}_i$ is the fitted value of the error-term from equation (2), i.e. the difference between observed and fitted values; AVE_SCORES_i is a variable representing average scores in reading and math of students participating in the INVALSI national student assessment for grade II and V; $ESCS_i$ represents the average socio-economic and cultural intake of each school, based on students' family background;[23] θ_i is the error-term.[24]

In detail, AVE_SCORES_i is obtained by applying the *Principal Component Analysis* (PCA), through which the set of observations of possibly correlated four average scores (reading for grade II; math for grade II; reading for grade V; math for grade V) is converted into a set of values of linearly uncorrelated variables so-called principal components. The correlation across such scores is confirmed by the correlation matrix reported in Table 9, wherein high and positive values emerge in all cases and the strongest correlation can be found considering the same grade (e.g., between the indexes of math and reading for II and V grade are 0.66 and 0.67, respectively).

Insert Table 9 about here

This is likely to imply some bias in the accuracy of the estimation if the four measures were used all together as regressors into equations (3a) and (3b), respectively. Hence, we implement the principal component transformation - yielding linearly independent components[25] - and take the first component, which explains 65.7% of the variability.[26]

The sub-sample of overfunded and underfunded schools are similar in terms of social and economic backgrounds and both feature advantaged as well as disadvantaged contexts; in the first sub-sample, *ESCS* shows an average value -0.097 and a standard deviation 0.492; while in the case of negative residuals, an average value -0.042 and a standard deviation 0.430. However, overfunded schools tend to be characterized by lower values of students' performance than underfunded schools, with *AVE_SCORES* ranging from -9.203 to 4.426 (mean -0.091) against values from -3.560 to 4.956 (mean 0.076).

[23] *ESCS* index is calculated by the INVALSI with a methodology similar to that used by OCSE-PISA.
[24] The INVALSI produces an annual survey of students' learning in classes II and V of primary schools (and in class I of lower secondary schools). The schools' participation in the INVALSI tests was voluntary for several years; from the school year 2009-2010, it has started to involve all schools and pupils of all classes. The administration of the tests is done directly by schools in a given date, following instructions provided by the INVALSI, except for schools part of the INVALSI national sample (i.e. the data used in this paper) where external observers administer the tests.
[25] More generally, the PCA is used mostly for data reduction purposes: for example, to get a small set of variables (preferably uncorrelated) from a large set of variables (most of which are correlated to each other) or to create indexes with variables that measure similar things (conceptually); when used as regressors, they can also solve the multicollinearity problem. As a matter of fact, principal components provide an alternative explanation of the observed variability with the advantage of being not correlated each other and ranked according to their weight in such explanation. This allows reducing the number of variables to be considered and preserving the total variability even passing from the observed variables to principal components. For more details see Johnson and Wichern (2002), and Abdi and Williams (2010).
[26] The results of the PCA are not reported in the paper but they are available upon request.

The estimation outputs of equations (3a) and (3b) are reported in Table 10.[27]

Insert Table 10 about here

$ESCS_i$ has a statistically significant effect on all schools and in both cases. As the social and economic background becomes more favourable, observed expenditure is closer to the standard benchmark. So this means that, in a more advantaged school context the model estimated in equation (2) - which considers only structural demand factors - provides a good representation of the actual financial needs.

Students' performance (AVE_SCORES_i) is statistically significant only for overfunded schools (where it tends also to be lower). Thus, we may infer that, all other factors being equal, the lower students' performance, the higher expenditure schools are experimenting respect to their standard requirement. In other words, quality issues suggest that increasing students' performance brings school expenditure closer to what it would be expected as their actual need.[28] Although we may not infer on the direction of the casual relationship, when students' performance is too low, assigning resources only on the basis of structural demand factors may not be realistic. Creating an incentive for worst performing schools to improve, by allowing them to spend, conditionally, more than their benchmark, could gradually reduce the overall amount of resources needed. [29]

For implementation purposes the standard school requirement should be firstly referred to the quantity and characteristics of the service provided (e.g., the type of school, the number of student, the type of students, other organization school aspects) rather than to students' outcomes, which could indirectly penalize weaker school backgrounds without providing solutions for their improvement. Notwithstanding, much attention has to be directed to the "quality" of inputs – particularly those perceived being relevant for policy such as teachers, who are (at least currently) not correlated to their cost and to specific curricular or extra-curricular projects that "work" (i.e. have positive effects on students' learning). The question here may be that of enhancing the capacity of schools in using the resources they have to implement relevant projects and to choose or attract better staff. Incentive mechanisms based on providing schools, which prove a good track in terms of improving students' performance with a small sum of additional resources on top of the estimated standard, could be a viable proposal in such direction.

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[27] Both models were estimated by using a FGLS model, following the Lewis and Lincer (2005) suggestion in the literature, according to which either OLS or WLS (*Weighted Least Squares*) in a second stage analysis are likely to be inefficient and may produce inconsistent estimates of parameter uncertainty due to heteroschedasticy problems.

[28] This also holds when regional context factors are controlled for. By introducing a dummy to represent Southern regions (where low performing schools are typically more concentrated), the results are similar although the effect is slightly lower in magnitude.

[29] In a view of understanding efficiency issues, over- and under-funded schools were also analyzed using efficiency scores obtained in Di Giacomo and Pennisi (2012) as a regressor in a FGLS model on both residuals. The results are similar to those discussed with reference to equations (3a) and (3b). School efficiency is statistically significant in the case of overfunded schools only, whereby an increase of a school's capability to maximize outputs on the basis of a given input also yields an overall expenditure closer to what should be expected on the basis of structural demand factors (coefficient -159.1). This should be no surprising, given that the efficiency scores here considered are highly correlated with math and reading scores, as well as with the AVE_SCORES_i variable.

7. Concluding remarks

In the current framework schools are endowed of a certain degree of autonomy through which they can manage their own budget to cover daily functioning needs and equipment, to promote specific education initiatives (e.g., extra-curriculum projects), and to address local needs. Beyond these actual competences, the ongoing fiscal federalism reform - which also regards the education sector - seems to drive towards increasing schools responsibilities and decision-power as concern the allocation of resources for implementing all education functions. In this perspective, and given the remarkable inherent variance in per student school spending today, it is relevant to identify funding criteria based on school needs rather than, for example, on their historical record and to enforce, to some extent, a hard budget constraint.

In order to shed some light on this issue, we propose an estimation of the standard financial requirement for primary schools using a statistical sample of about 1,000 schools (referring to two main types, specialized and comprehensive institutes) for the 2009/2010 school year, following a cost function approach where only structural demand factors are considered (i.e. the number of students to serve, the share of students with special education needs, the type of school, the number of service delivery points, and the share full-time classes). The second step is to compare such standard with the current endowment of each school to evaluate whether adjustments - to what extent and direction - should be made to move towards a "standard cost" principle.

The novelty of our analysis lies in considering the school viewpoint and performing the empirical investigation at the level of single school, rather than at the regional level - and for the teachers' requirement only - as done in previous studies (Biagi and Fontana 2009; Bordignon and Fontana 2010; IRPET 2012). In doing so, we propose two scenarios: the former tries to describe the current situation, while the latter advances a more decentralized framework under which schools are directly responsible for staff recruitment. In both cases, the main research question concerns how many resources should be given to each school to deliver ordinary running services.

Results of our model seem reasonably applicable to the decentralized scenario rather than for the current one, wherein the demand-side variables do not seem to properly explain school expenditure. On the other hand, the specification for the decentralized model fits well the data and highlights that the current endowment is quite far from the benchmark for all schools of the sample; indeed, most of them should receive more resources as they are below the standard. Additionally, schools above the standard - which should thus receive less - are highly concentrated in a few regions (e.g., Sardinia, Calabria, Campania, and Apulia).

Overfunded and underfunded schools are similar in terms of social and economic backgrounds, but the former tend to be characterized by lower values of students' performance than their underfunded counterparts. When exploring the relationship between the misallocation of resources

according to the standard requirement and quality issues - such as students' performance and social-economic background - the results suggest that a funding mechanism based on structural demand factors is likely to be realistic when the contextual conditions and average performance are both at a good level. More precisely, students' performance plays a role in explaining those cases wherein observed expenditure is higher than the standard requirement, but not in the opposite situation. Although the direction of the casual relationship is unknown, a funding mechanism strictly based on structural demand factors may not be sustainable if students' performance is too low. In order to gradually drive low performing schools to better results and reduced expenditure, it may be envisaged to allow them - at least in the short run - to spend more than their benchmark, subject to improvements in students' national assessment scores.

Finally, it is worth saying that this empirical exercise is made on a sample of schools; hence, it provides some evidence on the existing financial imbalance and a methodology to calculate the standard requirement, which should be actually extended to the whole of schools in order to be operative and effective, and also used for practical purposes. Probably, it would be also more appropriate to look upon the average expenditure over a few years instead of only over 2010. In doing so, future research should analyze more detailed breakdowns for the school budget as there are signs that these aggregated data could be actually affected by lack of homogeneity and consistency in recording practices, and do not highlight different agreements that schools may have with local governments on carrying for specific facilities.

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Tables and figures

Table 1 - *Descriptive statistics of some revenue and expenditure variables by region for the schools' sample* (values in euro per pupil).

	Mean		
Regions	**EU structural funds**	**Family and private sector contributions**	**Capital expenditure**
Piedmont	0.39	66.48	10.26
Liguria	0.88	75.67	6.36
Lombardy	0.09	65.86	3.74
Veneto	0.26	73.81	6.86
Friuli Venezia-Giulia	0.00	64.23	3.86
Emilia Romagna	0.05	65.16	6.18
Tuscany	0.88	74.34	6.43
Umbria	0.28	89.27	5.15
Marche	1.20	79.06	9.13
Lazio	0.48	151.74	10.14
Abruzzo	0.35	55.98	8.96
Molise	0.00	58.67	13.88
Campania	29.27	37.46	13.81
Apulia	50.40	35.61	18.89
Basilicata	4.11	49.57	10.33
Calabria	99.82	34.17	17.15
Sicily	55.57	43.83	17.18
Sardinia	0.34	56.36	14.49
Total	14.61	65.59	10.20

Note: Data for Valle d'Aosta and Trentino Alto Adige are not reported in the table as these autonomous Regions fund public schools directly.

Source: Authors' calculations

Table 2 - *Descriptive statistics of the explanatory variables.*

	Mean	*Sta. Dev*	*Min*	*Max*
N° students	640.13	220.38	122	1599
N° students_inverse	0.0018	0.0007	0.0006	0.0082
Share of full-time students	24.79	28.15	0	100
Share of disabled students	2.75	1.30	0	10
Type of school	0.54	0.50	0	1
N° service delivery points	2.88	1.43	1	9
Urban municipalities	0.34	0.47	0	1
Mountain municipalities	0.02	0.14	0	1

Source: Authors' calculations

Table 3 - *Descriptive statistics of the two dependent variables by region* (values in euro).

	School_EXP per student				**(School_EXP + Staff_EXP) per student**			
Regions	*Mean*	*Sta. Dev*	*Min*	*Max*	*Mean*	*Sta. Dev*	*Min*	*Max*
Piedmont	613	162	324	1078	4039	492	3063	5293
Liguria	545	162	297	994	4047	563	3096	6492
Lombardy	467	137	237	859	3732	436	2972	4695
Veneto	430	152	217	980	3555	391	2733	4520
Friuli V.G.	570	168	270	909	3968	562	2893	5255
Emilia Romagna	561	182	275	1250	3750	588	2877	6382
Tuscany	552	156	307	1048	3808	554	3019	6367
Umbria	605	196	333	1255	3988	527	2991	5315
Marche	508	190	103	1293	3758	547	2869	5494
Lazio	830	290	330	1697	4074	644	2875	5696
Abruzzo	728	262	313	1538	3999	886	2748	7006
Molise	652	304	273	1495	4309	1070	2838	6587
Campania	765	335	257	1674	3764	668	2402	5427
Apulia	693	276	216	1565	3645	706	2541	6386
Basilicata	614	194	252	1131	4331	943	2837	6493
Calabria	820	352	291	1731	4456	947	2898	6358
Sicily	639	255	201	1411	3932	889	2389	6440
Sardinia	828	276	306	1655	4430	795	2852	6495
Total	631	261	103	1731	3948	726	2389	7006

Note: Data for Valle d'Aosta and Trentino Alto Adige are not reported in the Table as these autonomous Regions fund public schools directly.

Source: Authors' calculations

Table 4 - *The current scenario*

Dependent variable	**School_EXP per student**	
Independent variables	*Coefficient*	*Significance Level*
N° students	-0.214	(**)
N° students_inverse	79093.05	(***)
Share of full-time students	0.692	(**)
Share of disabled students	29.328	(***)
Type of school	-75.132	(***)
N° service delivery points	12.359	(**)
Constant	533.845	(***)
Number of observations	1083	
F-test	45.4	(***)
R-squared	0.19	

Note: OLS with robust standard errors. Significance level: (***) 1%; (**) 5%; (*) 10%

Source: Authors' calculations

Table 5 - *The decentralized scenario*

Dependent variable	**(School_EXP + Staff_EXP) per student**	
Independent variables	*Coefficient*	*Significance Level*
N° students	-1.025	(***)
N° students_inverse	395963.30	(***)
Share of full-time students	8.317	(***)
Share of disabled students	121.493	(***)
Type of school	452.615	(***)
N° service delivery points	170.213	(***)
Constant	2625.604	(***)
Number of observations	1083	
F-test	301.9	(***)
R-squared	0.69	

Note: OLS with robust standard errors. Significance level: (***) 1%; (**) 5%; (*) 10%

Source: Authors' calculations

Table 6 - *Descriptive statistics of the fitted dependent variable and of the difference between observed and fitted values by region in the decentralized scenario* (in euro).

	Fitted (School_EXP + Staff_EXP) per student	**Observed *minus* fitted dependent variable**			
Regions	*Mean*	*Mean*	*Sta. Dev*	*Min*	*Max*
Piedmont	4167	-129	308	-901	672
Liguria	4212	-164	297	-734	542
Lombardy	3838	-106	303	-734	689
Veneto	3730	-175	300	-920	548
Friuli Venezia-Giulia	3959	9	303	-645	1028
Emilia Romagna	3761	-12	373	-736	1371
Tuscany	3867	-59	270	-673	812
Umbria	4084	-96	377	-2005	347
Marche	3968	-210	323	-1149	692
Lazio	4015	59	378	-682	893
Abruzzo	3995	4	425	-529	1550
Molise	4508	-199	505	-764	1398
Campania	3602	162	387	-639	1337
Apulia	3450	196	419	-627	1557
Basilicata	4299	32	421	-909	846
Calabria	4170	287	528	-510	1669
Sicily	3876	56	436	-772	1341
Sardinia	4174	256	452	-783	1490

Note: Data for Valle d'Aosta and Trentino Alto Adige are not reported in the Table as these autonomous Regions fund public schools directly. The grey colour highlights schools with a positive gap between observed expenditure and the standard, i.e. they should receive fewer resources to meet the standard.

Source: Authors' calculations

Table 7 - *The distribution of frequency of the difference between observed and fitted values over observed values at the national level in the decentralized scenario.*

Class definition	***Class number***	***Frequency***	***Percent***	***Cum.***
From -40% to -30%	1	2	0.2	0.2
From -30% to -10%	2	174	16.1	16.3
From -10% to 0%	3	413	38.1	54.4
From 0% to 10%	4	357	33.0	87.4
From 10% to 20%	5	112	10.3	97.7
Over 20%	6	25	2.3	100
	Total	*1,083*	*100*	

Source: Authors' calculations

Table 8 - *The distribution of frequency of the difference between observed and fitted values over observed values by region in the decentralized scenario.*

Class definition		From -40% to -30%	From -30% to -10%	From -10% to 0%	From 0% to 10%	From 10% to 20%	Over 20%	
Class number		**1**	**2**	**3**	**4**	**5**	**6**	
Regions	*N° schools*				Percentage values			Total
Piedmont	*69*		20.3	46.4	30.4	2.9		100
Liguria	*52*		23.1	51.9	23.1	1.9		100
Lombardy	*67*		20.9	41.8	32.8	3.0	1.5	100
Veneto	*76*		26.3	48.7	22.4	2.6		100
Friuli V. G.	*50*		12.0	36.0	42.0	8.0	2.0	100
Emilia Romagna	*71*		15.5	38.0	35.2	8.5	2.8	100
Tuscany	*73*		13.7	45.2	35.6	5.5		100
Umbria	*45*	2.2	13.3	33.3	51.1			100
Marche	*62*	1.6	33.9	35.5	27.4	1.6		100
Lazio	*65*		12.3	38.5	30.8	18.5		100
Abruzzo	*54*		13.0	46.3	31.5	5.6	3.7	100
Molise	*29*		48.3	24.1	17.2	6.9	3.5	100
Campania	*61*		4.9	27.9	44.3	19.7	3.3	100
Apulia	*68*		8.8	20.6	42.7	20.6	7.4	100
Basilicata	*46*		13.0	43.5	28.3	15.2		100
Calabria	*60*		3.3	31.7	35.0	20.0	10.0	100
Sicily	*74*		17.6	37.8	21.6	21.6	1.4	100
Sardinia	*61*		1.6	31.2	41.0	19.7	6.6	100

Note: Data for Valle d'Aosta and Trentino Alto Adige are not reported in the Table as these autonomous Regions fund public schools directly.

Source: Authors' calculations

Table 9 - *Correlation matrix of the average scores.*

	Average scores in reading II	Average scores in math II	Average scores in reading V	Average scores in math V
Average scores in reading II	1.00			
Average scores in math II	0.66	1.00		
Average scores in reading V	0.51	0.43	1.00	
Average scores in math V	0.44	0.54	0.67	1.00

Source: Authors' calculations

Table 10 - *Residuals estimation.*

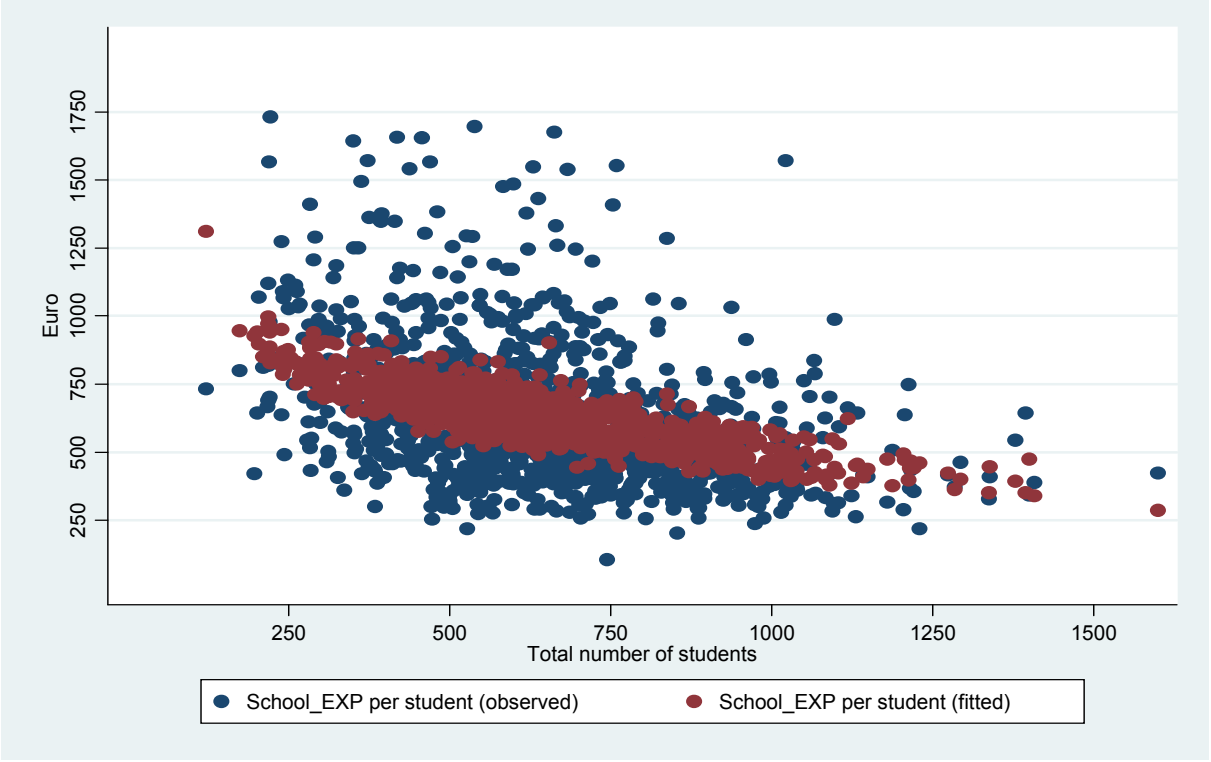
Dependent variable	**(a) Positive residuals from equation (2)**	
Independent variables	*Coefficient*	*Significance Level*
AVE_SCORES	-14.325	(***)
ESCS	-57.788	(***)
Constant	317.860	(***)
Number of observations	494	
Wald chi2	2236.1	(***)

Dependent variable	**(b) Negative residuals from equation (2)**	
Independent variables	*Coefficient*	*Significance Level*
AVE_SCORES	-1.685	
ESCS	20.641	(***)
Constant	-277.587	(***)
Number of observations	589	
Wald chi2	226.1	(***)

Note: FGLS with robust standard errors. Significance level: (***) 1%; (**) 5%; (*) 10%

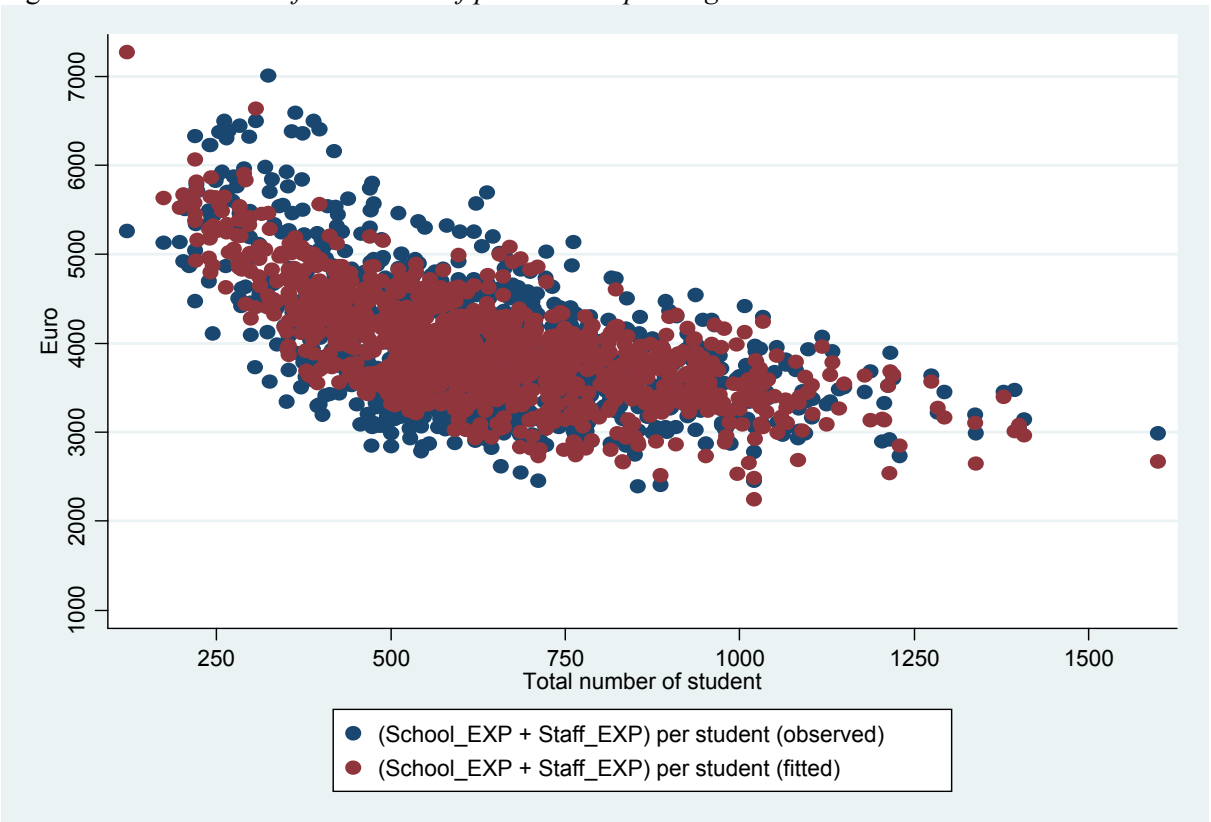
Source: Authors' calculations

Figure 1 - *Observed and fitted values of per student spending under the current scenario.*



Source: Authors' calculations

Figure 2 - *Observed and fitted values of per student spending under the decentralized scenario.*



Source: Authors' calculations

APPENDIX

Table A.1 - *Representativeness of the sample used to estimate the standard needs.*

Regions	*Schools sample INVALSI*	*Schools sample used for the standard need*	*Schools sample coverage*	*Population (number of students)*	*Students sample INVALSI*	*Students sample used for the standard need*	*Students sample coverage*
Piedmont	82	69	84.1	177876	4850	37344	21.0
Liguria	64	52	81.3	55216	3671	26042	47.2
Lombardy	91	67	73.6	412881	5886	40390	9.8
Veneto	84	76	90.5	216724	5176	43315	20.0
Friuli V. G.	57	50	87.7	48641	3175	25842	53.1
Emilia-Romagna	80	71	88.8	177692	5565	45151	25.4
Tuscany	80	73	91.3	145633	4940	40156	27.6
Umbria	50	45	90.0	36747	2930	22774	62.0
Marche	65	62	95.4	67135	3698	28253	42.1
Lazio	88	65	73.9	230660	5419	35182	15.3
Abruzzo	64	54	84.4	54951	3652	26262	47.8
Molise	37	29	78.4	13261	1536	8304	62.6
Campania	91	61	67.0	293144	5197	32204	11.0
Apulia	84	68	81.0	202672	5572	38155	18.8
Basilicata	51	46	90.2	27031	2319	15603	57.7
Calabria	78	60	76.9	93417	3544	23401	25.1
Sicily	90	74	82.2	249197	4866	32608	13.1
Sardinia	71	61	87.3	66497	3290	23948	36.0

Note: Data for Valle d'Aosta (21 sample schools) and Trentino Alto Adige (39 schools in Trento and 18 schools in Bolzano provinces) are not reported in the Table as these autonomous Regions fund public schools directly.

Source: Authors' calculations